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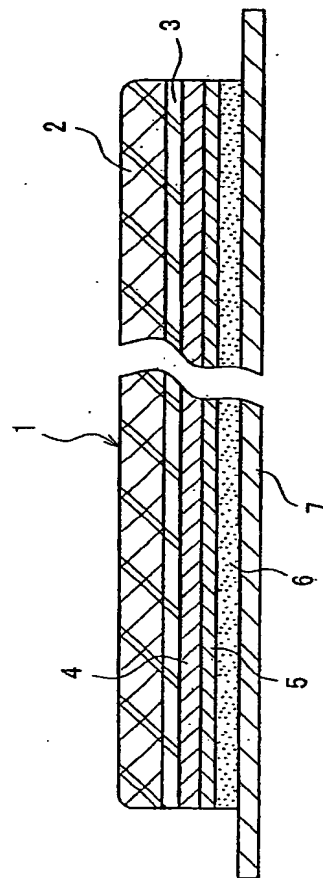
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**(54) SHEET MATERIAL WITH HIGH DUCTILITY AND METHOD OF PRODUCING THE SAME**

(57) High stretchable sheet material according to the invention is adapted to maintain the flexibility of an ink applied to a base over an extended period of time, so that the sheet material may be even stuck on a curved portion, which increases the stretch ratio of the base, without suffering the degradation of the color or glossy appearance thereof. The high stretchable sheet material of the invention is arranged such that a binding/reinforcing layer (3) is formed on a back side of a base (2) formed of a synthetic resin sheet by impregnating a binder into the base (2), the binder including an ink (11) exhibiting a high flexibility in a dry state, and that a back side of the binding/ reinforcing layer (3) is covered by an adhesive layer (6) and a separator sheet (7) adhered to a back side of the adhesive layer.

**FIG. 1**



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er and the adhesive layer, so that the pattern layer may impart a variety of picture patterns and color tones to the high stretchable sheet material.

[0013] The above high stretchable sheet material wherein the base is formed with the binding/ reinforcing layer by impregnating the ink into the base may be manufactured, for example, using the screen printing technique.

[0014] That is, a method for manufacturing a high stretchable sheet material according to the present invention is characterized in that an ink exhibiting a high flexibility in a dry state is applied to a back side of a base formed of a synthetic resin sheet by way of screen printing with the setting of a mesh coarser than that specified by the standard for use of the ink (standard specification of the ink) and the applied ink is dried, and that an adhesive is applied to a back side of the base coated with the ink so as to stick a separator sheet on the base.

[0015] If the screen printing using the coarse mesh is performed on the base formed of the synthetic resin sheet, the amount of ink applied to the base is increased so much that the base is impregnated with the ink, the flexibility of which increases the elongation percentage of the base. Thus, the base is allowed to exhibit quite a high stretchability.

[0016] In a case where the high stretchable sheet material is formed with a pattern layer according to the above manufacturing method, the following procedure may be taken. After the aforesaid ink is dried, a different ink exhibiting a high flexibility in a dry state is applied to print a desired picture pattern on the back side of the base and is dried. Subsequently, the adhesive is applied to the back side of the base coated with the different ink so as to stick the separator sheet on the base.

[0017] On the other hand, if the flexible ink for forming the pattern layer is applied to the base after the ink impregnated into the base to form the binding/reinforcing layer and to increase the elongation percentage of the base is dried, as described above, the solvent in the ink impregnated into the base to form the binding/reinforcing layer causes the ink forming the pattern layer to blur so that a desired color tone or picture pattern may not be obtained.

[0018] Therefore, the pattern layer may previously be formed on the back side of the base and then, the binding/reinforcing layer may be formed on the back side of the pattern layer.

[0019] That is, a second high stretchable sheet material according to the present invention is characterized in that a pattern layer including an ink exhibiting a high flexibility in a dry state is formed on a back side of a base formed of a synthetic resin sheet; that a binding/reinforcing layer is formed on a back side of the pattern layer by impregnating a binder into the base from the back side of the pattern layer, the binder including an ink of the same type based on the same solvent as that of the ink exhibiting a high flexibility in a dry state and forming the pattern layer; and that a back side of the binding/

reinforcing layer is covered by an adhesive layer and a separator sheet adhered to a back side of the adhesive layer.

[0020] In this case, the pattern layer is formed on the back side of the base before the ink (binder) for increasing the elongation percentage of the base is impregnated therein. Therefore, the ink forming the pattern layer does not blur during the formation of the pattern layer on the back side of the base. Furthermore, since the binding/reinforcing layer formed on the back side of the pattern layer includes the ink of the same type based on the same solvent as that of the ink forming the pattern layer, the solvent penetrates through the pattern layer to be impregnated into the base, thereby further increasing the elongation percentage of the base.

[0021] According to the second high stretchable sheet material, there may be provided a high stretchable sheet material offering a high elongation percentage without degrading the color tone of the pattern layer or the appearance of the picture pattern.

[0022] The second high stretchable sheet material wherein the binding/ reinforcing layer is formed on the back side of the pattern layer by impregnating the ink may also be manufactured using the screen printing technique, for example.

[0023] That is, a method for manufacturing the second high stretchable sheet material according to the present invention is characterized in that a desired picture pattern is formed on a back side of a base formed of a synthetic resin sheet, using an ink exhibiting a high flexibility in a dry state and then the ink is dried; that a different ink exhibiting a high flexibility in a dry state and based on the same solvent as that of the former ink is applied to a back side of the base coated with the former ink by way of screen printing with the setting of a mesh coarser than that specified by the standard for use of the latter ink and then the ink is dried; and that an adhesive is applied to the back side of the base coated with the latter ink so as to stick a separator sheet on the base.

#### Brief Description of the Drawings

[0024]

FIG. 1 is a sectional view showing a high stretchable sheet material according to the present invention; FIG. 2 is a group of diagrams explanatory of the steps of manufacturing the sheet material, FIG. 2A representing a perspective view of a base and a plate, FIG. 2B representing a perspective view showing a step of forming a binding/ reinforcing layer; FIG. 3 is a group of diagrams explanatory of the steps of manufacturing the sheet material, FIG. 3A representing a perspective view showing a drying step, FIG. 3B representing a perspective view showing a step of forming a pattern layer;

Screen Ink" (trade name, otherwise known as a gloss ink for polyester); "SG700 series" inks (trade name) commercially available from Seiko Advance Ltd.; and the like.

[0036] The properties of the above "Sericol SP2100 AU-Clear" are as follows. The ink exhibits an elongation of 180% as stretched at a rate of 200 mm/min and a tensile strength of 2.0 kg/ 15 mm as stretched at the same rate as the above. As to the heat resistance, no failure is observed after 168-hour heating at 80°C.

[0037] Accordingly, the binding/reinforcing layer 3 with the above binder impregnated into the base 2 has such a high stretchability (a property to exhibit an extremely high degree of elongation under conditions where defects including cracks and the like do not occur) that even when the sheet material is stuck on a small article having many curved portions of small curvature radii, such as a cellular telephone or a mouse of a personal computer, the sheet material provides neat finish with ease.

[0038] The pattern layer 4 and the coat layer 5 may employ an ink which has similar composition to that of the binder used in the binding/ reinforcing layer 3 but has a different color or a clear color. Otherwise, a suitable ink may be selected from those normally used in the screen printing.

[0039] An acrylic adhesive of organic solvent type, for example, may preferably be used as the adhesive for forming the adhesive layer 6 because the adhesive serves a packing function to prevent the solvent component from evaporating from the binding/reinforcing layer 3, the pattern layer 4 and the coat layer 5.

[0040] Next, a method for manufacturing the high stretchable sheet material 1 according to one embodiment of the present invention will be described with reference to FIG. 2 and FIG. 3.

[0041] First, as shown in FIG. 2, the ink 11 exhibiting a high flexibility in a dry state is applied to one side of the base 2 by screen printing. A plate 12 used by the screen printing process includes a screen 13 having a mesh coarser than that specified by the standard for use of the ink 11.

[0042] In the case of the above "Sericol SP2100 AU-Clear", for example, the standard for use thereof specifies a proper mesh to be in the range of 180 to 225. In the case of the "Sericol EG Screen Ink", the standard for use thereof specifies a proper mesh to be on the order of 230. The embodiment specifies a proper mesh for the screen 13 of the plate 12 to be 120, which is nearly twice as coarse as specified by the standard for use of this ink.

[0043] By using such a coarse screen 13, a substantially large amount of ink 11 is supplied onto the base 2. As a result, a sufficient amount of ink 11 is assuredly impregnated into the base 2.

[0044] FIG. 4A shows an example of a screen printing press 15 used for this screen printing process. The printing press 15 has a structure wherein a plate-12 setting

portion 16 is located centrally of the press while a doctor blade 17 and a squeegee 18 are adapted to move over the plate 12. The plate 12 includes a tetron screen 13.

[0045] The application of the ink 11 is followed by the curing of the ink 11, which is performed for a predetermined period of time to allow the ink 11 to dry. The drying process may employ a suitable heating apparatus 20 for heating the ink, as shown in FIG. 3.

[0046] FIG. 4B shows an exemplary outside appearance of the heating apparatus 20. The heating apparatus incorporates therein a thermostatic oven with internal air circulation (not shown). However, it is also possible to use a heating apparatus of another heating system. In this case, the heating temperature may preferably be in the range of 30°C or more to 80°C or less. The reason is as follows. If the temperature is lower than 30°C, the flexibility of the ink 11 may not be developed sufficiently. If the heating temperature exceeds 80°C, there is a possibility that the sheet material 1 so manufactured may suffer surging.

[0047] Even though the heating temperature is in the range of 30°C or more to 80°C or less, the following cases involve the following problems. If the heating temperature is less than 50°C, the drying time tends to be increased. If the heating temperature is in excess of 70°C, the sheet material 1 may suffer minor flaws, which occur rarely. Therefore, it is practically preferable that the heating temperature is in the range of 50°C or more to 70°C or less. The optimum heating conditions are a heating temperature of 60°C and a heating time of 15 minutes.

[0048] It is noted that all the specific examples of the base 2 of the marking film or of the ink 11 clear the heat resistance of 70°C. Some of the examples even clear the heat resistance of 80°C. Therefore, it is not difficult to obviate a problem that the base 2 and the ink 11 are damaged by the heat during the drying process.

[0049] After the ink 11 is dried, the base 2 with the ink 11 impregnated therein is set again in the screen printing press 15, where the same ink 11 is applied to the base 2 under the same conditions as the above, the ink 11 exhibiting a high flexibility in a dry state. Subsequently, the heating apparatus 20 is operated for drying the ink 11 under the same conditions as the above.

[0050] In this manner, the application and dry cycle for the same ink 11 having the excellent flexibility is repeated plural times, whereby the ink 11 is more assuredly impregnated into the base 2. It is thus ensured that an even greater amount of ink is applied to the base. As a result, the sheet material 1 having an even more excellent stretchability can be obtained.

[0051] It is noted, however, that the greater number of repetition of the application and dry cycle for the ink 11 does not necessarily lead to the better result. Three or more repetitions of the application and dry cycle do not result in a noticeable increase of the effect. This suggests that it is the most efficient to repeat the application and dry cycle for the ink 11 twice.

hesive layer 6 till the time of use (sticking) of the high stretchable sheet material 1. On the other hand, the adhesive layer 6 and the separator sheet 7 cover the back sides of the binding/reinforcing layer 3 and the pattern layer 4, thereby serving to prevent the solvent component in these layers 3, 4 from evaporating out of these layers.

**[0067]** The base 2 of this embodiment accounts for a base sheet portion of a marking film of a synthetic resin based on polyolefin. Examples of this marking film include L-Round Series (trade name) commercially available from Lintec Corporation. Examples of the binder for increasing the elongation percentage of the polyolefin base 2 as impregnated therein include EG Screen Ink (trade name) commercially available from Teikoku Printing Inks Mfg. Co., Ltd.

**[0068]** Next referring to FIG. 7 and FIG. 8, description is made on a method for manufacturing the high stretchable sheet material 1 according to the second embodiment of the present invention.

**[0069]** First, as shown in FIG. 7, the ink 23 exhibiting a high flexibility in a dry state is applied to one side of the above base 2 by performing the screen printing according to the conventionally known method. Thus, the desired picture pattern 26 is printed on the base 2.

**[0070]** Used as the ink 23 for forming such a pattern layer 4 is one that exhibits, in a dry state, the same level of flexibility as that of the ink 11 for forming the binding/reinforcing layer 3 or has a certain level of flexibility which is higher than that of the ink 11. In the frame of the plate 24 employed by this screen printing process, the screen 25 is formed with the desired picture pattern 26 (which may be designed for homochromatic printing). Unlike the formation of the binding/reinforcing layer 3 to be described hereinafter, the plate may employ the screen having a mesh in the range of 230 to 300.

**[0071]** After such a screen printing process, the ink may be dried by means of the heating apparatus 20 as shown in FIG. 8A, or may be allowed to dry naturally. Subsequently, as shown in FIG. 8B, the aforesaid ink 11 exhibiting a high flexibility in a dry state is applied to the back side of the pattern layer 4 by screen printing. The ink 11 used in this case is the same type of ink based on the same solvent as the ink 23 for forming the aforesaid picture pattern 26. The plate 12 used by the screen printing process includes the screen 13 having a mesh coarser than that specified by the standard for use of the ink 11. For instance, the mesh is nearly twice as coarse as specified by the standard for use of the ink.

**[0072]** By using such a coarse screen 13, a substantially large amount of ink 11 (binder) is supplied to the pattern layer 4 on the base 2. As a result, a sufficient amount of ink 11 is allowed to impregnate into the base 2 through the pattern layer 4.

**[0073]** Subsequently, the adhesive is applied to the back side of the binding/reinforcing layer 3 by the conventionally known method (the application of the adhesive may also be performed in the aforesaid screen

printing press 15). Thereafter, the separator sheet 7 is stuck on the back side of the adhesive layer 6 thus formed, whereby the manufacture of the high stretchable sheet material 1 of the second embodiment is completed.

**[0074]** According to the high stretchable sheet material 1 of the second embodiment as described above, the pattern layer 4 is previously formed on the back side of the base 2 before the ink 11 (binder) for increasing the elongation percentage of the base is impregnated therein. Therefore, the ink 23 is prevented from blurring when the picture pattern 26 is printed on the back side of the base 2. In addition, the binding/reinforcing layer 3 formed on the back side of the pattern layer 4 includes the ink 11 of the same type based on the same solvent as that of the ink 23 forming the pattern layer 4 and hence, the solvent penetrates through the pattern layer 4 to be impregnated into the base 2, thereby increasing the elongation percentage of the base 2. Accordingly, there may be obtained the high stretchable sheet material 1 achieving the high elongation percentage without degrading the color tone of the pattern layer or the appearance of the picture pattern.

**[0075]** It is noted that the present invention is not limited to the foregoing embodiments.

**[0076]** For instance, the high stretchable sheet material 1 according to the present invention may be used as stuck not only on the laptop computer 30 but also on any kind of articles including portable articles such as cellular telephones, pocket pagers, CD players and MD players; vehicle bodies such as of automobiles, motor cycles and bicycles and all kinds of automotive parts such as rear-view mirror bodies; stationary articles and articles for daily use; domestic articles such as carved ornaments; and the like.

**[0077]** Furthermore, other usage purposes are not limited, which include expression of individual characters; so-called reorganization of a room; patch-up or coverage of a defaced portion or damaged portion; attachment of an emblem; and the like.

**[0078]** As described above, the present invention is adapted to maintain the flexibility of the ink applied to the base over an extended period of time so that the high stretchable sheet material may be stuck even on a curved portion, which increases the stretch ratio of the base, without suffering the degradation of the color or glossy appearance thereof.

#### Industrial Application

**[0079]** The high stretchable sheet material of the present invention may be used as stuck on portable articles such as laptop computers, cellular telephones, pocket pagers, CD players and MD players; vehicle bodies such as of automobiles, motor cycles and bicycles and automotive parts.

FIG. 1

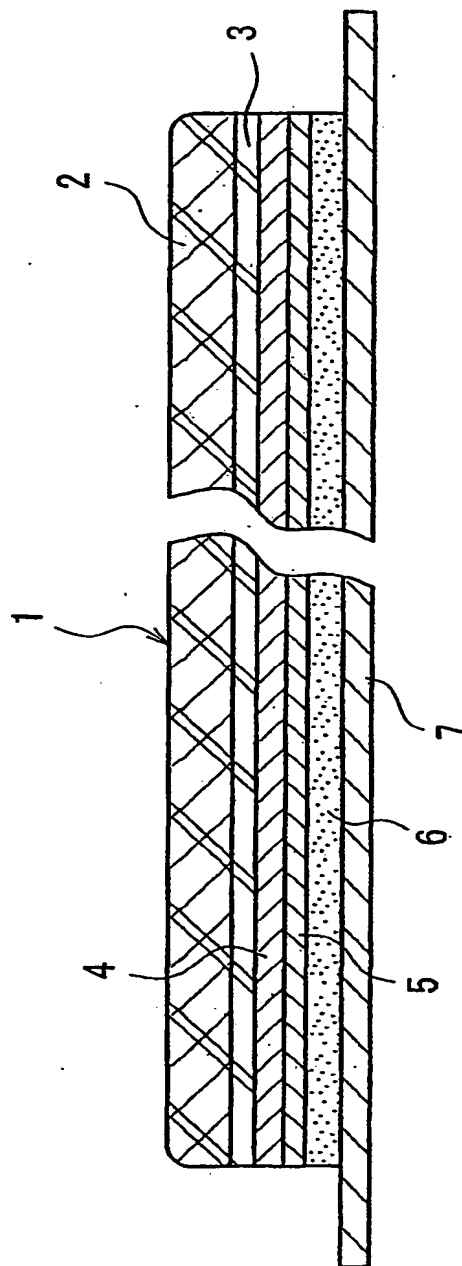
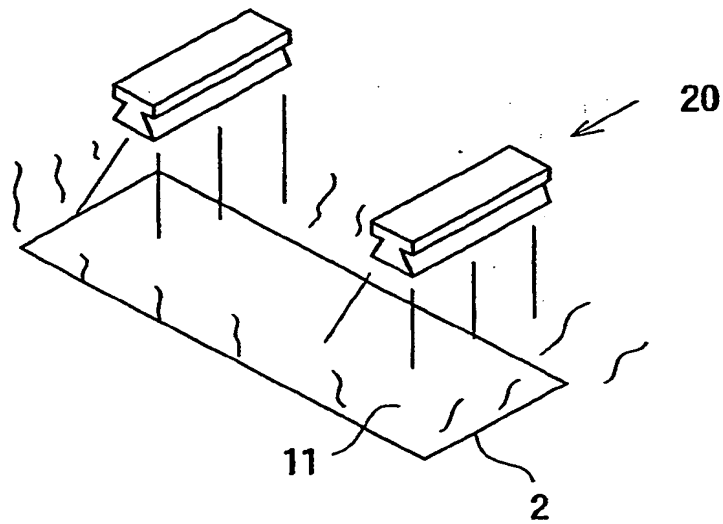
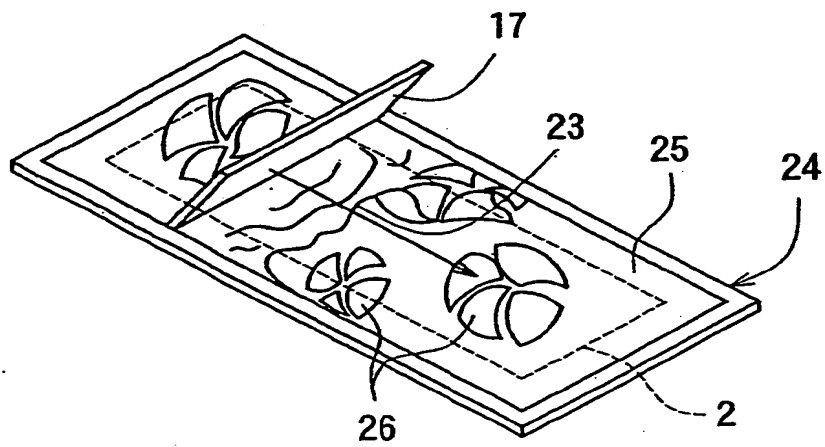


FIG. 3

(a)

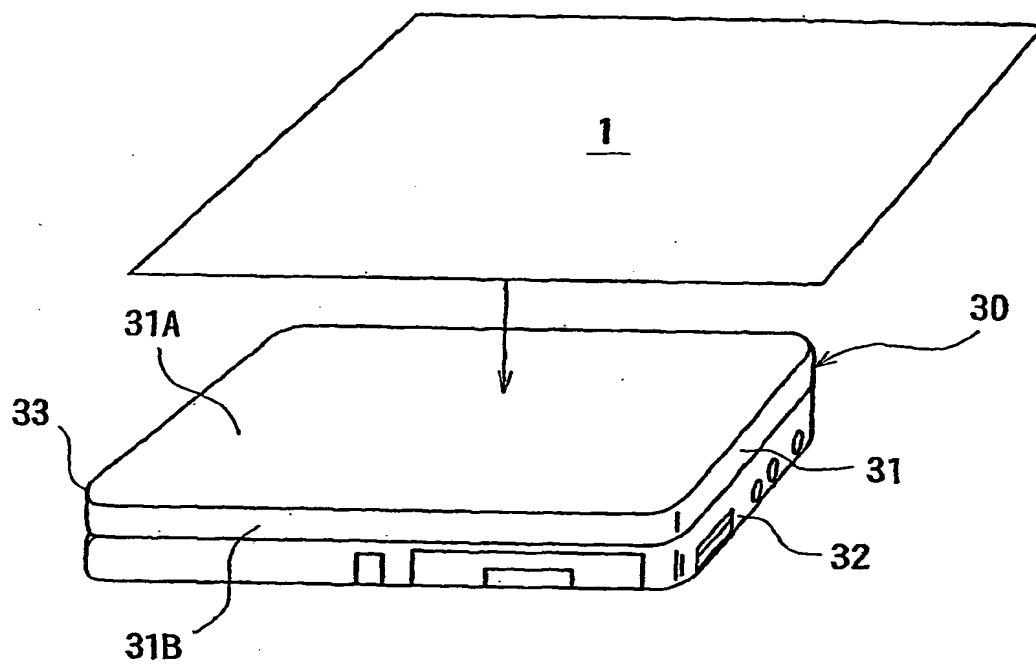


(b)



*FIG. 5*

(a)



(b)

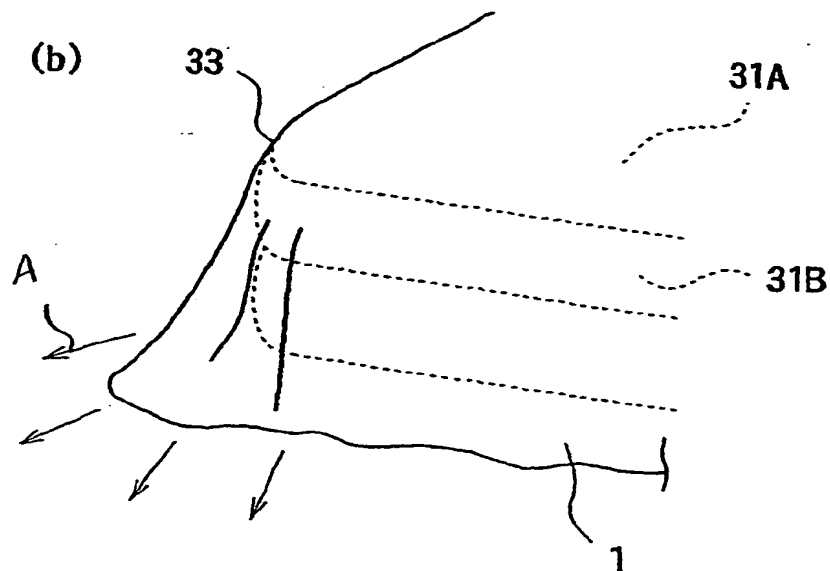
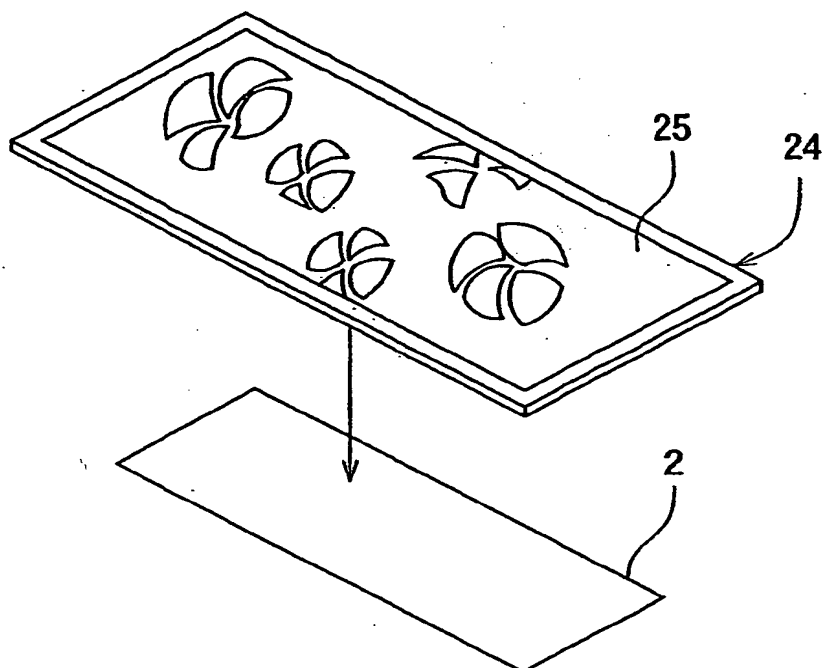
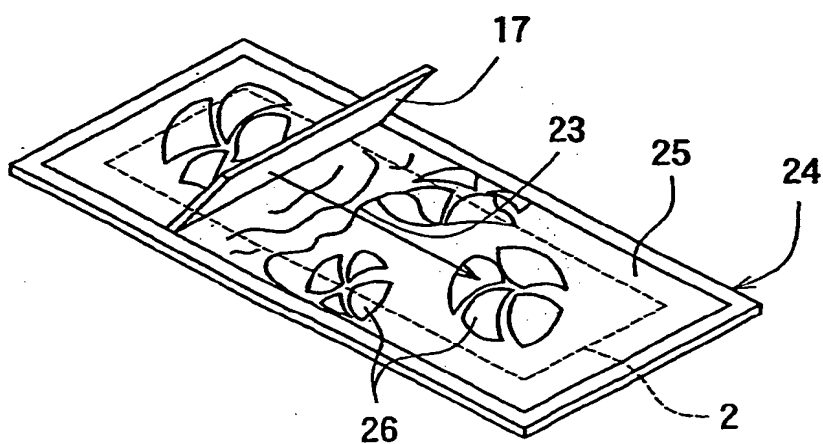


FIG. 7

(a)



(b)





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/13340

A. CLASSIFICATION OF SUBJECT MATTER  
Int.Cl.<sup>7</sup> C09J7/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
Int.Cl.<sup>7</sup> C09J7/02Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2002  
Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 7-11202 A (Sekisui Chemical Co., Ltd.), 13 January, 1995 (13.01.95), Claims; Par. No. [0008] (Family: none)	3, 4 1, 2, 5, 6
A	JP 2000-326618 A (Tomohide HASEGAWA), 28 November, 2000 (28.11.00), Claims (Family: none)	1-6
A	JP 63-54484 A (Nippon Carbide Industries Co., Ltd.), 08 March, 1988 (08.03.88), Claims; page 2, lower left column, line 14 to page 3, upper left column, line 16 (Family: none)	1-6

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search  
13 November, 2003 (13.11.03)Date of mailing of the international search report  
02 December, 2003 (02.12.03)Name and mailing address of the ISA/  
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